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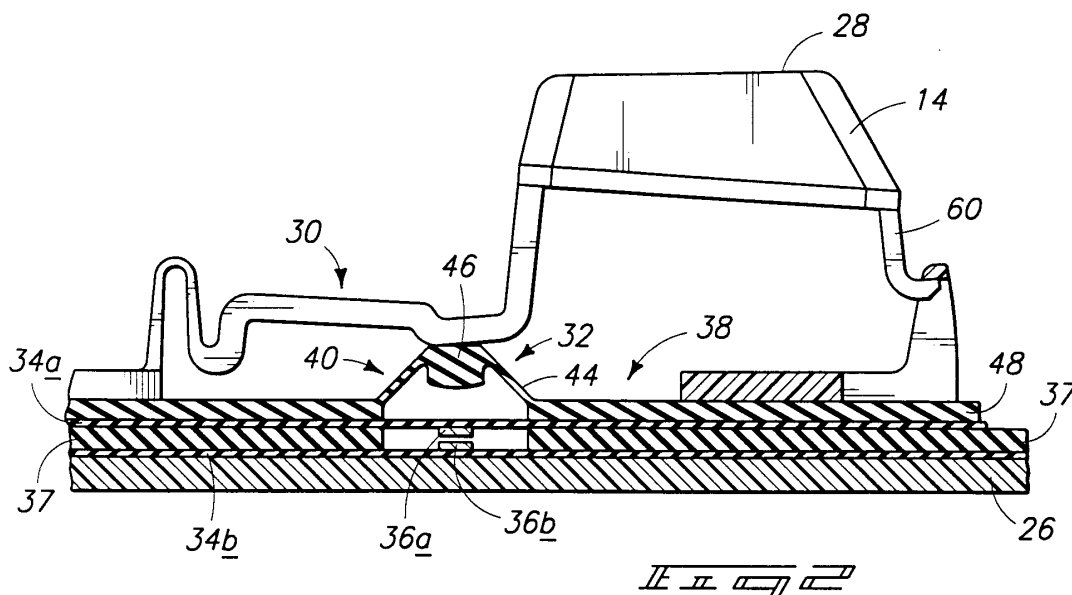
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(54) **Ergonomic computer keyboard**

(57) A computer keyboard system 10 is illustrated having a keyboard array of keys 14 that are utilized for activating digital membrane keyswitches 32 for providing informational electrical signals to a computer. Each key 14 has an elastomeric dome 40 for resisting downward movement of a keytop 28, 50 from an un-depressed position to an actuation position and for returning the keytop 28, 50 to an un-depressed position when the actuation force is released. Each dome 40 has a collapsible side wall 44. The keys 14 are subdivided into groups 68, 70, 72, and 74 associated with the index fin-

ger, middle finger, ring finger and little finger, respectively. The collapsible side walls 44 of the domes 40 associated with the little and ring fingers are thinner than the side walls 44 of the side walls associated with the index and middle fingers so that less force is required to actuate the keys in groups associated with the ring and little fingers than that required to actuate the keys in groups associated with the index and middle fingers. Additionally the forces required to actuate a group of peripheral and control keys is greater than that required to actuate the alphabetical keys.



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Description

Technical Field

[0001] This invention relates to ergonomic computer keyboards having membrane keyswitches.

Background Art

[0002] There is increasing awareness and concern in many industries involving the ergonomics of consumer products. "Ergonomics" is an applied science concerned with the characteristics of product users which must be considered in designing products in order for the user and products to interact most effectively and safely. In the field of data processing, product designers are concerned with manufacturing more "user friendly" computer monitors, keyboards, desks, and chairs to provide a more comfortable, productive, and safe environment for the user.

[0003] With this in mind, manufacturers of computer products have designed keyboards with special key contours and arrangements to facilitate more natural movement and extension of a user's fingers, hands and forearm. Keyboard wrist supports are sometimes provided to promote proper hand placement and inclination. In many cases such "ergonomic" solutions have rather dramatically increased the cost of the keyboards and, in many cases, increased the cost beyond the price that the keyboard purchasers are willing to pay.

[0004] Furthermore it is generally recognized that the user's index finger and middle fingers have stronger sets of muscles than their ring and little fingers. Consequently the force used by a computer keyboard operator to manipulate the keys is generally greater for those keys that are actuated by the index and middle fingers than those manipulated by the ring and little fingers. Furthermore, computer keyboard operators, particularly those that do extensive word processing, may experience fatigue in the little and ring fingers prior to experiencing fatigue in the middle and index fingers.

[0005] It should be noted that with a "QWERTY" keyboard layout, the left hand little finger is called upon to actuate the often used vowel key "a". The left hand ring finger normally actuates the popular consonant keys "s" and "w". The right ring finger is normally called upon to actuate the vowel key "o", the popular consonant key "l", and the end of sentence key ".". The right hand little finger is called upon to actuate the popular consonant key "p".

[0006] Considerable research has been conducted to develop a more "user friendly" alternative to the "QWERTY" keyboard arrangement (key locations) so that the little and ring fingers would be used less often than the middle and index fingers when the keyboard operator is involved in "heavy duty" word processing. Most of the research has been conducted with the hope that keyboarding speed skills could be improved by re-arranging

the layout of the keyboard so that the most frequently used keys were actuated with the stronger middle or index fingers. Although many alternatives have been suggested, such alternatives have not been widely adopted.

[0007] Further, although not widely known, it has been found that many keyboard operators have a "dominate" hand in which the fingers of the dominate hand apply a greater force to the keyboard keys than the fingers of the "less-dominate" hand. For example, right-handed persons generally depress the keyboard keys with a greater force when using their right hand fingers than when using their left hand fingers. This generally results from the fact that for right-handed persons, their right hand fingers are stronger than their left hand fingers. Just the opposite appears to be true for a left-handed person.

[0008] Thus for a right-handed "heavy-duty" keyboard operator, their left hand fingers may tire before their right hand fingers. If the keyboard operator is left-handed, then their right hand fingers may tire before their left hand fingers.

[0009] Furthermore it has been known for many years that as a general rule, men's fingers are stronger than women's fingers with men actuating the keyboard keys with a greater force than women. Consequently when using keyboards with the same tactile characteristics, a woman's fingers may tire sooner than a man's fingers.

[0010] One of the principal objectives of this invention is to provide an ergonomic computer keyboard that accommodates the varying strength of different fingers of "heavy duty" keyboard users, such as word processors, to minimize finger fatigue.

[0011] Another principal objective of this invention is to provide an ergonomic computer keyboard that reduces the likelihood that one set of fingers would become overly fatigued prior to the operator taking a rest break or being involved in other stress relieving procedures.

[0012] A further principal objective of this invention is to provide an ergonomic computer keyboard that reduces the likelihood that the little or ring fingers would become overly fatigued prior to the operator taking a rest break or being involved in other stress relieving procedures.

[0013] A still further principal objective of this invention is to provide an ergonomic computer keyboard having a very low cost solution for reducing finger fatigue for a computer keyboard operator that is involved with extensive word processing.

[0014] An additional principal objective of this invention is to provide a computer keyboard having the ability to reduce finger fatigue without substantially adding to the cost of manufacture.

[0015] These and other objectives and advantages will become apparent upon reviewing the following detailed description of a preferred embodiment and alternate embodiment of this invention in conjunction with the drawings.

Brief Description of the Drawings

[0016]

Fig. 1 is a plan view of a preferred embodiment of a computer keyboard system incorporating the present invention showing a computer keyboard array of keys;

Fig. 2 is a fragmentary vertical cross-section view of a typical key having a digital informational membrane keyswitch showing the key in the un-depressed position;

Fig. 3 is a fragmentary vertical cross-sectional view similar to Fig. 2, except showing the key in the depressed "break over" actuation position;

Fig. 4 is a fragmentary vertical cross-sectional view of an alternate key having a digital informational membrane keyswitch in which the key is shown in the un-depressed position;

Fig. 5 is a fragmentary vertical cross-sectional view similar to Fig. 4 except showing the key in the depressed position activating the digital informational membrane keyswitch;

Fig. 6 is an isolated fragmentary vertical cross-sectional view of two elastomeric dome return springs in which the elastomeric dome on the right side of the Figure has a thicker wall requiring a larger force to depress the associated key than the thinner wall of the elastomeric dome on the left side of the Figure;

Fig. 7 is a plan view of the computer keyboard shown in Fig. 1 emphasizing a group of keys associated with the index fingers within an alphabetical section;

Fig. 8 is a plan view of the computer keyboard shown in Fig. 1 emphasizing a group of keys associated with the middle fingers within the alphabetical section;

Fig. 9 is a plan view of the computer keyboard shown in Fig. 1 emphasizing a group of keys associated with the ring fingers within the alphabetical section;

Fig. 10 is a plan view of the computer keyboard shown in Fig. 1 emphasizing a group of keys associated with the little fingers within the alphabetical section;

Fig. 11 is a plan view of the computer keyboard shown in Fig. 1 emphasizing a group of numerical and calculator pad keys;

Fig. 12 is a plan view of the computer keyboard shown in Fig. 1 emphasizing a group of function and cursor control keys;

Fig. 13 is a plan view of the computer keyboard shown in Fig. 1 emphasizing a certain group of control keys; and

Fig. 14 is a schematic graph of the "break over" and "over-travel" force-versus-stroke curves for different groups of full travel keys requiring different ac-

tuation forces to activate the keys.

Best Modes for Carrying Out the Invention and Disclosure of Invention

[0017] Referring to the drawings, there is illustrated a preferred embodiment of a computer keyboard, generally designated with the numeral 10. The computer keyboard 10 includes a keyboard housing 12 for receiving a plurality of keyboard keys 14 to input data or control signals to a computer. The computer keyboard 10 includes keyboard keys 14 that are formed in a keyboard array having an alphabetical section 16, a numeric section 17, a function key section 18, a cursor control section 20, and a calculator keypad section 22. Computer keyboard system 10 further includes a visual indicator or LED section 24 for supplying visual warning signals to the computer operator.

[0018] Generally all of the computer keyboard keys 14 are of the same general structure; however, that is not always necessary. Figures 2 and 3 illustrate one specific key structure that is a preferred arrangement.

[0019] The computer keyboard 10 includes a general base or back plate 26 that generally supports the keys 14. Each of the keys includes a keytop 28 that is supported by a keytop support 30. In the embodiment shown in Figs. 2 and 3, the keytop support 30 is in the form of a key lever. More detail of the key lever structure may be found in U.S. Patent No. 5,329,079, granted July 12, 1994, and assigned to Key Tronic Corporation, the same assignee as the present invention. Each key 14 includes a digital membrane keyswitch 32 that generates a computer digital input electrical signal when activated. The digital membrane keyswitch 32 includes two flexible membrane layers 34a and 34b that have printed circuits formed with opposing digital switch contacts 36a and 36b at each key location. The membrane layers 34a and 34b are preferably separated by a spacer layer 37. The key structure includes an elastomeric dome return spring 38 for resisting the downward movement of the keytop 28 and for biasing the keytop 28 to an "up" un-depressed position, as shown in Fig. 2. The flexible membrane layer 34 is supported on a rigid back plate 26.

[0020] In the preferred embodiment, the elastomeric dome return spring 38 includes an elastomeric dome sheet 48 having an elastomeric dome 40 at each switch location. Fig. 2 illustrates the keytop 28 in the un-depressed position with the dome 40 biasing the keytop 28 to its un-depressed position. Fig. 3 illustrates the end result of the depression of the keytop 28 from the un-depressed position through an intermediate actuation position to a final over-travel position, in which the dome 40 is collapsed to activate the digital membrane keyswitch 32 and to provide "over-travel." The elastomeric dome 40 has an anvil 46 that engages the top membrane layer 34a and moves it downward to move the contact 36a into electrical contact with contact 36b to

generate an electrical signal. Each of the elastomeric domes 40 includes a flexible side support wall 44 that is collapsible when a required force is applied to an anvil portion 46 of the dome 40, as shown in Fig. 3. The dome 40 provides a resistive force to the downward movement of the keytop 28 and defines the "tactile feel" (break over) and force-to-fire characteristics of the key 14. When the operator removes the activation pressure or force, the dome 40 returns the keytop 28 to its undepressed position illustrated in Fig. 2.

[0021] An alternate type of key structure is illustrated in Figs. 4 and 5. Rather than a key lever arrangement, the key 14 has a keytop 50 with a keystem or plunger 51 supported by a key support or monoblock 52. The plunger 51 is slidably supported on the monoblock 52 for "full-travel" between the two extreme positions illustrated in Figs. 4 and 5. A lower portion of the keystem 51 engages the anvil 46 of the dome 40, causing the dome 40 to move downward to a collapsed condition illustrated in Fig. 5, through a force-to-stroke relationship such as illustrated in Fig. 14.

[0022] Referring to Fig. 14, there is illustrated a force-versus-stroke graph showing a force curve 90 that represents the force-versus-stroke (travel) relationship of the "full-travel" keys 14. The force curve 90 has an initial depression segment 92 in which the key is initially depressed a substantial distance by the keyboard user in which the force required to depress the key is progressively increasing. Upon further depression, the key-stroke enters the break over segment 94 in which the force required to further depress the keytop dramatically decreases. Such dramatic force change provides the operator with a "tactile feel" that the keyswitch is being actuated to provide feedback to the operator that the operator has been successful in activating the keyswitch at activation point 98.

[0023] The digital membrane keyswitch 32 is designed to generate the computer input signal at the actuation point 98. Further downward movement of the keytop causes the keytop to move through the overtravel segment 100 of the curve. It should be noted that the force required to move the keytop downward in the overtravel segment 100 rapidly increases assuring the operator that the key has been actuated.

[0024] An important part of this invention is to provide a low cost structure to be able to vary the force required to activate different groups or sets of keys 14 within the alphabetical section 16, depending upon which finger is normally used to actuate the key.

[0025] For example, the alphabetical section 16 may be sub-divided into a first group 68 of alphabetical keys 14 that are normally actuated by the operator's index fingers (see Fig. 7). For example, alphabetical keys "r t y u f g h j v b n m" are normally actuated by the operator's index fingers (see Fig. 7). It is desirable that each key of first group 68 be actuated with an actuation force (force-to-fire) in the range of between 35 grams and 75 grams inclusive, with a preferred actuation force value

of approximately 55 grams.

[0026] A second group 70 of alphabetical keys 14 are normally operated by the operator's middle fingers (see Fig. 8). Such group 70 keys generally includes the alphabetical keys "e d c l k ,". It is desirable that each of the keys of the second group 70 be actuated with an actuation force (force-to-fire) in the range of between 34 grams and 54 grams, with a preferred actuation force value of approximately 44 grams.

[0027] A third group 72 of alphabetical keys are normally actuated by the operator's ring fingers such as "w s x o 1 ." (see Fig. 9). It is desirable that each alphabetical key of the third group 72 be actuated with an actuation force (force-to-fire) in the range of between 24 grams and 40 grams inclusive, with a preferred actuation force value of approximately 32 grams.

[0028] A fourth group 74 of alphabetical keys 14 are normally actuated by the operator's little fingers (see Fig. 10). Such group 74 of keys normally includes the keys - "q a z p ; / [']." It is desirable that each key of the fourth group 74 be actuated with an actuation force (force-to-fire) in the range of 21 grams and 37 grams inclusive, with a preferred actuation force value of approximately 29 grams.

[0029] It is important that the actuation force required to actuate the keys in the groups 72 and 74 be significantly less than the force required to actuate the keys in the groups 68 and 70. It is desirable that the differential force required to actuate keys in the groups 68 and 70 be in a range of between 5 grams and 15 grams inclusive greater than that required to actuate keys in the groups 72 and 74. Preferably the force required to actuate the keys in the groups 68 and 70 be 10 grams or more greater than that required to actuate keys in the groups 72 and 74.

[0030] In the preferred embodiment, such differential actuation forces are accomplished by making the side walls 44 of the elastomeric domes 40 associated with the keys in the groups 72 and 74 thinner than the side walls 44 of the elastomeric domes 40 associated with the keys of the groups 68 and 70, as illustrated in Fig. 6. As previously mentioned the domes 40 may be incorporated as elements of a dome sheet or interconnecting web 48 or may be separate individual dome elements.

[0031] A numeric and calculator or fifth group 78, illustrated in bold line in Fig. 11, is composed of the numeric section 17 and the calculator pad section 22 (less the "num lock" key). It is desirable that each of the keys 14 in the group 78 require an actuation force in the range of 35 grams to 75 grams inclusive, with a preferred actuation force value of approximately 55 grams.

[0032] A peripheral or sixth group 80, as illustrated in bold line in Fig. 12, preferably includes (1) the keys in the function section 18, (2) the keys in the cursor control section 20, and (3) the following keys at the edge of the alphabetical section 16 - "Tab", Left and Right "Shift", and "Enter".

[0033] It is desirable that each of the keys in the pe-

ripheral group 80 require an actuation force (force-to-fire) in the range of between 44 grams and 75 grams inclusive, with a preferred actuation force value of approximately 60 grams. It is desirable that the differential force required to actuate keys in group 80 be in a range of between 5 grams and 25 grams inclusive greater than that required to actuate keys in groups 68, 70, 72 and 74. Preferably the force required to actuate the keys in group 80 be 10 grams or more greater than that required to actuate keys in the groups 68, and 70 and 20 grams greater than that required to actuate keys in the groups 72 and 74.

[0034] In the preferred embodiment, such differential actuation forces are accomplished by making the side walls 44 of the elastomeric domes 40 associated with the keys in groups 68, 70, 72 and 74 thinner than the side walls 44 of the elastomeric domes 40 associated with the keys in group 80. Consequently, the side walls 44 of the domes 40 associated with the keys in groups 72 and 74 are thinner than the side walls 44 associated with the keys in the groups 68 and 70, and the side walls 44 of the domes 40 associated with the keys in the group 68 and 70 are thinner than the side walls 44 associated with the keys in group 80.

[0035] Furthermore, it is desirable to provide that keys 14 within a control group or seventh group 84, require actuation forces greater than those required to actuate the keys in the groups 68, 70, 72 and 74 and preferably greater than those required to actuate keys in the groups 78 and 80. The keys in the group 84 include "Caps Lock", "Alt", "Ctrl" space bar, Windows logo, and "Num Lock" which are outlined in bold line in Fig. 13.

[0036] It is desirable that each of the control keys in group 84 are actuated with an actuation force (force-to-fire) in the range of between 63 grams and 97 grams inclusive, with a preferred actuation force value of approximately 80 grams. It is desirable that the differential force required to actuate keys in group 84 be in a range of between 25 grams and 55 grams inclusive greater than that required to actuate keys in group 68, 70, 72 and 74 and in a range of between 15 grams and 45 grams inclusive greater than that required to actuate keys in group 80. Preferably the actuation force required to actuate the keys in group 84 be (1) 45 grams or more greater than that required to activate keys in the groups 72 and 74, (2) 35 grams or more greater than that required to actuate keys in the groups 68, 70, and 78 and (3) 25 grams or more greater than that required to actuate keys in group 80.

[0037] In the preferred embodiment, such differential actuation forces are accomplished by making the side walls 44 of the elastomeric domes 40 associated with the keys in groups 68, 70, 72, 74 and 80 thinner than the side walls 44 of the elastomeric domes 40 associated with the keys in group 84. Consequently, the side walls 44 of the domes 40 associated with the keys of groups 68, 70, 72, 74 and 78 are thinner than the side walls 44 associated with the keys in group 80, and the

side walls 44 associated with the keys 80 are thinner than the side walls 44 associated with the keys of group 84.

[0038] Fig. 14 illustrates a keyboard force-versus-stroke diagram depicting six different force curves 90a-90f. Force curve 90a represents the force-vs-travel relationship for the keys within the fourth key group 74 associated with keys that are normally actuated by the little finger. The curve 90a shows an actuation magnitude of approximately 29 grams. Force curve 90b represents the force-vs-travel relationship for the keys within the third group 72 associated with keys that are normally actuated by the ring finger. The curve 90b shows an actuation magnitude of approximately 32 grams.

[0039] Force curve 90c represents the force-vs-travel relationship for the keys within the second group 70 associated with keys that are normally actuated by the middle finger. The curve 90c show an actuation magnitude of approximately 44 grams. Force curve 90d represents the force-vs-travel relationship for the keys within the first group 68 associated with keys that are normally actuated by the index finger. The curve 90d depicts an actuation force magnitude of approximately 55 grams.

[0040] Force curve 90e represents the force-vs-travel relationship for the keys within the fifth group 78 generally associated with keys that are peripheral to the alphabetical groups of keys. The curve 90e depicts an actuation force magnitude of approximately 55 grams. Force curve 90f represents the force-vs-travel relationship for the keys within the sixth group 80 associated with function and cursor control keys. The curve 90f illustrates an actuation force magnitude of approximately 60 grams. Force curve 90g represents the force-vs-travel relationship for the control keys 14 with the seventh group 84 associated with special control keys. The force curve 90g illustrates an actuator force magnitude of approximately 80 grams.

[0041] An alternate embodiment of this invention is to provide a computer keyboard that is gender specific. One keyboard is designed for use by men and a second is designed for use by women. Or one keyboard may be provided with two different dome sheets 48, one for men and the second for women. The user or seller would select the correct dome sheet 48 and insert it into the keyboard. The women's dome sheet 48 has domes 44 with side walls that are thinner than the side walls of the domes 44 of the men's dome sheet 48.

[0042] Preferably the first set of keys 68 associated with the index fingers of a man's hands require an actuation force of between 45 grams and 75 grams inclusive, with a preferred value of approximately 60 grams. Whereas the first set of keys 68 associated with the index fingers of a woman's hands require an actuation force of between 35 grams and 55 grams, with a preferred value of approximately 45 grams.

[0043] The second set of keys 70 associated with the middle fingers of a man's hands require an actuation

force of between 36 grams and 54 grams inclusive, with a preferred value of approximately 45 grams. The second set of keys 70 associated with the index fingers of a woman's hands require an actuation force of between 34 grams and 52 grams inclusive, with a preferred value of approximately 43 grams.

[0044] The third set of keys 72 associated with the ring fingers of a man's hands require an actuation force of between 24 grams and 40 grams, with a preferred actuation force of approximately 32 grams. The third set of keys 72 associated with the ring fingers of a woman's hands required an actuation force of between 24 grams and 36 grams, with a preferred actuation force of approximately 30 grams.

[0045] The fourth set of keys 74 associated with the little fingers of a man's hands require an actuation force of between 23 grams and 37 grams, with a preferred actuation force of approximately 30 grams. The fourth set of keys 74 associated with the little fingers of a woman's hands require an actuation force of between 21 grams and 29 grams, with a preferred actuation force of approximately 25 grams.

[0046] A further embodiment involves providing a keyboard with one group of keys associated with the operator's dominate hand that requires a larger actuation force to activate the keys than another group of keys normally associated with the operator's less dominate hand. Normally an operator's right hand is dominate and stronger if the operator is "right handed." For a "left handed" operator, normally their left hand is stronger and is dominate.

[0047] Consequently the side support walls 44 of the elastomeric dome return springs associated with the operator's dominate hand are thicker than the side support walls 44 of the elastomeric dome return springs associated with the operator's less-dominate hand. The side supported walls 44 thicknesses are adjusted so that actuation force required to actuate the keys associated with the less dominate hand is between five percent and fifteen percent smaller than the actuation force required to actuate the keys associated with the dominate hand.

Claims

1. A computer keyboard system comprising:

a plurality of keys arranged in a computer keyboard array having an alphabetical section with a first group of keys that are normally associated with the operator's index fingers, a second group of keys that are normally associated with the operator's middle fingers, a third group of keys that are normally associated with the operator's ring finger, and a fourth group of keys that are normally associated with the operator's little fingers;
each key having a movable keytop for move-

ment in a downward keystroke from an un-depressed position to an actuation position; each key having an elastomeric dome return spring with collapsible side support walls (1) for resisting downward movement of the keytop requiring the operator to apply an actuation force of sufficient magnitude to overcome the resistance; and (2) for moving the keytop in an upward keystroke from the actuated position to the un-depressed position when the keytop is released by the keyboard operator;

each key having a membrane keyswitch for generating a computer input electrical signal when the keyboard operator applies the necessary actuation force to the keytop to move the keytop in the downward keystroke to the actuation position; and

wherein the elastomeric dome return springs of one of the groups of alphabetical keys have different physical resistance characteristics than the elastomeric dome return springs of one of the other groups of alphabetical keys in which the actuation forces necessary to collapse the side support walls of the elastomeric dome return springs of the one group of alphabetical keys are less than the actuation forces necessary to collapse the side support walls of the elastomeric dome return springs of the other group of alphabetical keys.

2. The computer keyboard system as defined in claim 1 wherein the side support walls of the elastomeric dome return springs associated with the one group of alphabetical keys are thinner than the side support walls of the elastomeric dome return springs associated with the other group of alphabetical keys.

3. The computer keyboard system as defined in claim 1 wherein side support walls associated with the fourth group of alphabetical keys are thinner than the collapsible side support walls of the elastomeric dome return springs associated with the second group of alphabetical keys.

4. The computer keyboard system as defined in claim 1 wherein side support walls associated with the third and fourth groups of alphabetical keys are thinner than the collapsible side support walls of the elastomeric dome return springs associated with the first and second groups of alphabetical keys.

5. The computer keyboard system as defined in claim 1 wherein the actuation forces for the third and fourth groups of keys are selected from a range of between 21 grams and 40 grams inclusive and wherein the actuation forces for the first and second group of alphabetical keys are selected from a

range of between 34 grams and 75 grams inclusive and wherein the actuation forces for the third and fourth groups of keys are less than the actuation forces for the first and second group of alphabetical keys.

6. The computer keyboard system as defined in claim 5 wherein the actuation forces for the fourth group of keys are selected from a range of between 21 grams and 37 grams and the actuation forces for the second group of keys are selected from a range of between 34 grams and 54 grams. 10
7. The computer keyboard system as defined in claim 1 wherein the array of keys includes a peripheral group of keys peripheral to the alphabetical section of keys and wherein the actuation forces required to actuate the peripheral keys are greater than the actuation force required to actuate the fourth group of alphabetical keys. 20
8. The computer keyboard system as defined in claim 7 wherein actuation forces required to actuate the peripheral group of keys are selected from a range of between 44 grams and 75 grams inclusive and wherein the actuation force required to actuate the alphabetical section of keys are selected from the range of between 21 grams and 75 grams. 25
9. The computer keyboard system as defined in claim 7 wherein the actuation forces required to actuate the peripheral group of keys are selected from a range of between 5 grams to 15 grams inclusive greater than the actuation forces required to actuate the third and fourth groups of alphabetical keys. 30
10. The computer keyboard system as defined in claim 1 wherein the array of keys includes a control group of keys and wherein the actuation force required to actuate the control group of keys is greater than the actuation force required to actuate the alphabetical section of keys. 35
11. The computer keyboard system as defined in claim 10 wherein the elastomeric dome return springs for the control group of keys have thicker collapsible side support walls than the collapsible side support walls of the alphabetical section of keys. 40
12. The computer keyboard system as defined in claim 10 wherein the actuation forces required to actuate the control group of keys are selected from a range of between 12 grams to 25 grams inclusive greater than the actuation forces required to actuate the alphabetical section of keys. 45
13. The computer keyboard system as defined in claim 10 wherein the actuation forces required to actuate

the control group of keys are selected from a range of between 63 grams and 97 grams inclusive.

14. The computer keyboard system as defined in claim 5 in which the actuation forces required to actuate the first and second group of alphabetical keys is more than 10 grams greater than the actuation forces required to actuate the third and fourth group of alphabetical keys. 5
15. The computer keyboard system as defined in claim 1 wherein at least one of the groups of keys has a first sub-group associated with fingers of an operator's dominate hand and a second sub-group associated with fingers of an operator's less-dominate hand and wherein the first and second sub-groups have elastomeric dome return springs with side support walls in which the side support walls of the second sub-group are thinner than the side support walls of the first sub-group so that the applied force required to actuate the keys of the first sub-group are greater than the applied force required to actuate the keys of the second sub-group. 10
16. The computer keyboard system as defined in claim 15 wherein the applied force required to actuate the first sub-group of keys is between five percent and fifteen percent greater than the applied force required to actuate the second sub-group of keys. 15
17. The computer keyboard system as defined in claim 1 wherein the elastomeric dome return springs for one of the group of keys are selected from a gender category consisting of male elastomeric dome return springs and female elastomeric dome return springs and wherein both male and female elastomeric dome return springs have side support walls and wherein the female elastomeric dome return springs have thinner walls than the male elastomeric dome return springs so that the applied forces required to actuate keys having male elastomeric dome return springs are greater than the applied forces required to actuate keys having female elastomeric dome return springs. 20
18. The computer keyboard system as defined in claim 17 wherein the one group of keys is the first group. 25
19. A computer keyboard system comprising:
a plurality of alphabetical keys arranged in a computer keyboard array;
each alphabetical key having a movable keytop for movement in a downward keystroke from an un-depressed position to an actuation position;
each alphabetical key having an elastomeric dome return spring with collapsible side support walls (1) for resisting downward movement 30

of the keytop requiring the operator to apply an actuation force of sufficient magnitude to overcome the resistance; and (2) for moving the keytop in an upward keystroke from the actuated position to the un-depressed position when the keytop is released by the keyboard operator;

each alphabetical key having a membrane key-switch for generating a computer input electrical signal when the keyboard operator applies the necessary actuation force to the keytop to move the keytop in the downward keystroke to the actuation position; and

wherein the elastomeric dome return springs are selected from a gender category of male elastomeric dome return springs and female elastomeric dome return springs and wherein the side support walls associated with the female elastomeric dome return springs are thinner than the side support walls associated with the male elastomeric dome return springs so that the applied force required to actuate keys having male elastomeric dome return springs is greater than the applied force required to actuate keys having female elastomeric dome return springs.

20. A computer keyboard system comprising:

a plurality of keys arranged in a computer keyboard array having an alphabetical section with a first group of keys and a second group of keys;

each key having a movable keytop for movement in a downward keystroke from an un-depressed position to an actuation position;

each key having an elastomeric dome return spring with collapsible side support walls (1) for resisting downward movement of the keytop requiring the operator to apply an actuation force of sufficient magnitude to overcome the resistance; and (2) for moving the keytop in an upward keystroke from the actuated position to the un-depressed position when the keytop is released by the keyboard operator;

each key having a membrane keyswitch for generating a computer input electrical signal when the keyboard operator applies the necessary actuation force to the keytop to move the keytop in the downward keystroke to the actuation position; and

wherein the elastomeric dome return springs of the second group of alphabetical keys have thinner side support walls than the elastomeric dome return springs of the first group of alphabetical keys so that the actuation forces necessary to collapse the side support walls of the elastomeric dome return springs of the second

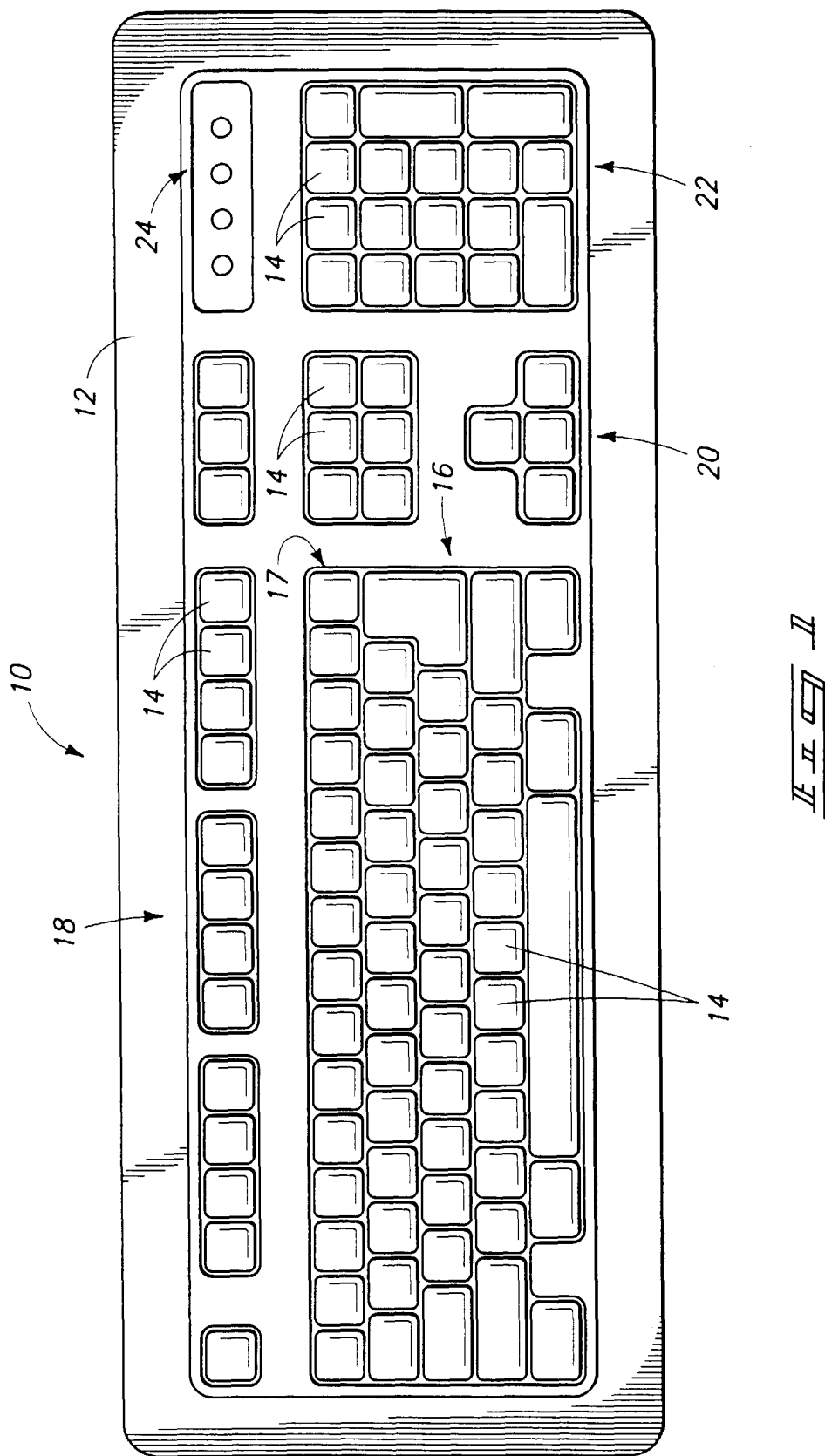
group of alphabetical keys are less than the actuation forces necessary to collapse the side support walls of the elastomeric dome return springs of the first group of alphabetical keys.

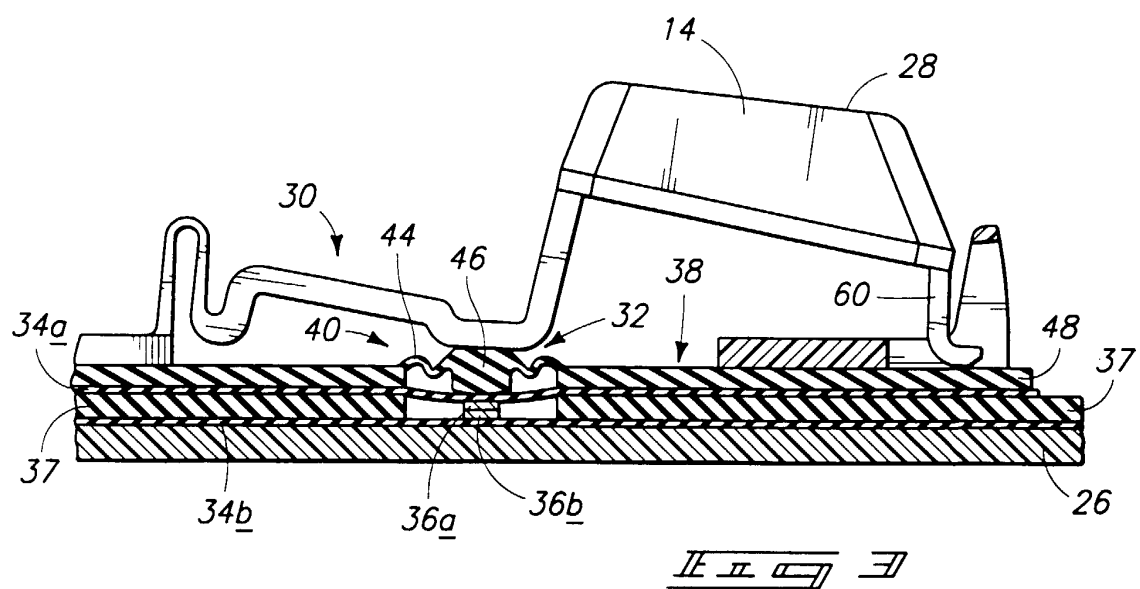
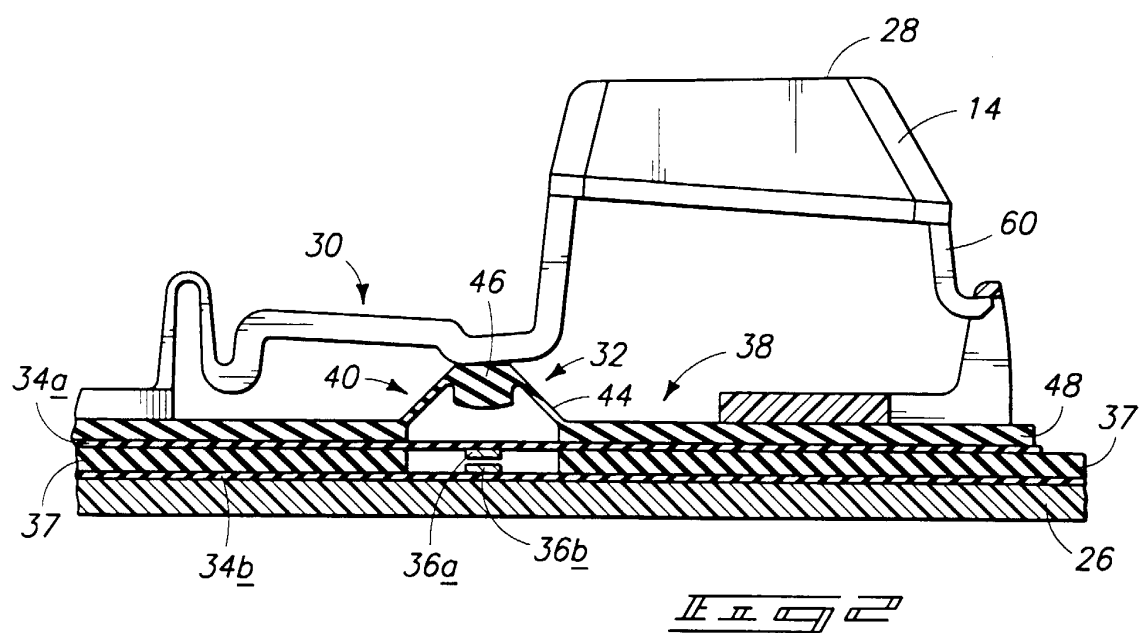
21. The computer keyboard system as defined in claim 20 wherein the computer keyboard array has a third group of keys with elastomeric dome return springs having side support walls that are thinner than the side support walls of the second group of keys.

22. The computer keyboard system as defined in claim 20 where the second group of keys is associated with keys that are normally actuated by the operator's ring fingers.

23. The computer keyboard system as defined in claim 20 wherein the first group of keys are associated with fingers of an operator's dominate hand and the second group of keys are associated with fingers of the operator's less dominate hand so that the actuating forces required to actuate the first group of keys associated with fingers of the dominate hand are greater than the actuating forces required to actuate the second group of keys associated with fingers of the less dominate hand.

24. The computer keyboard system as defined in claim 23 wherein the actuating forces required to actuate the first group of keys is between five percent and fifteen percent greater than the actuating force required to actuate the second group of keys.





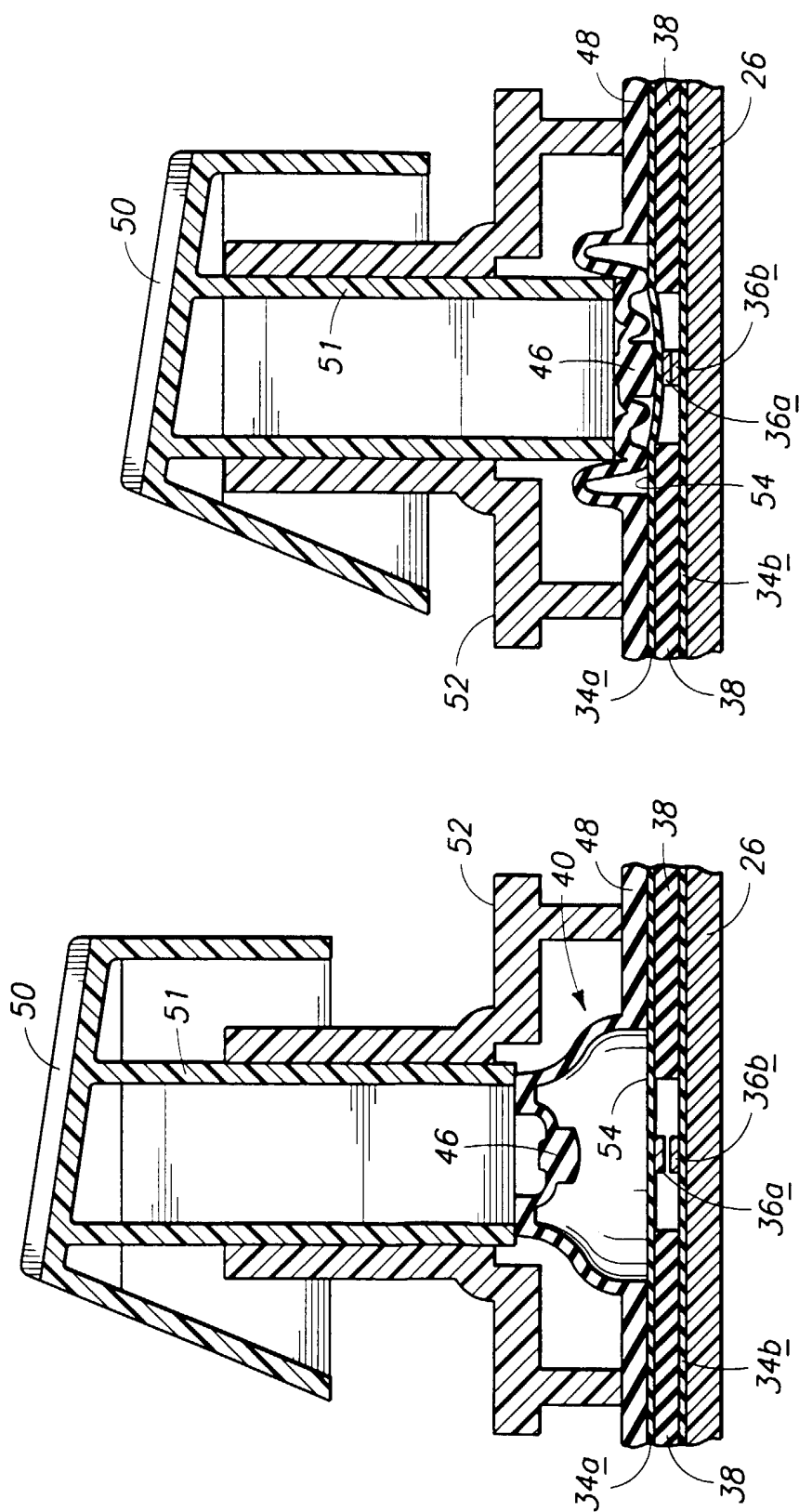
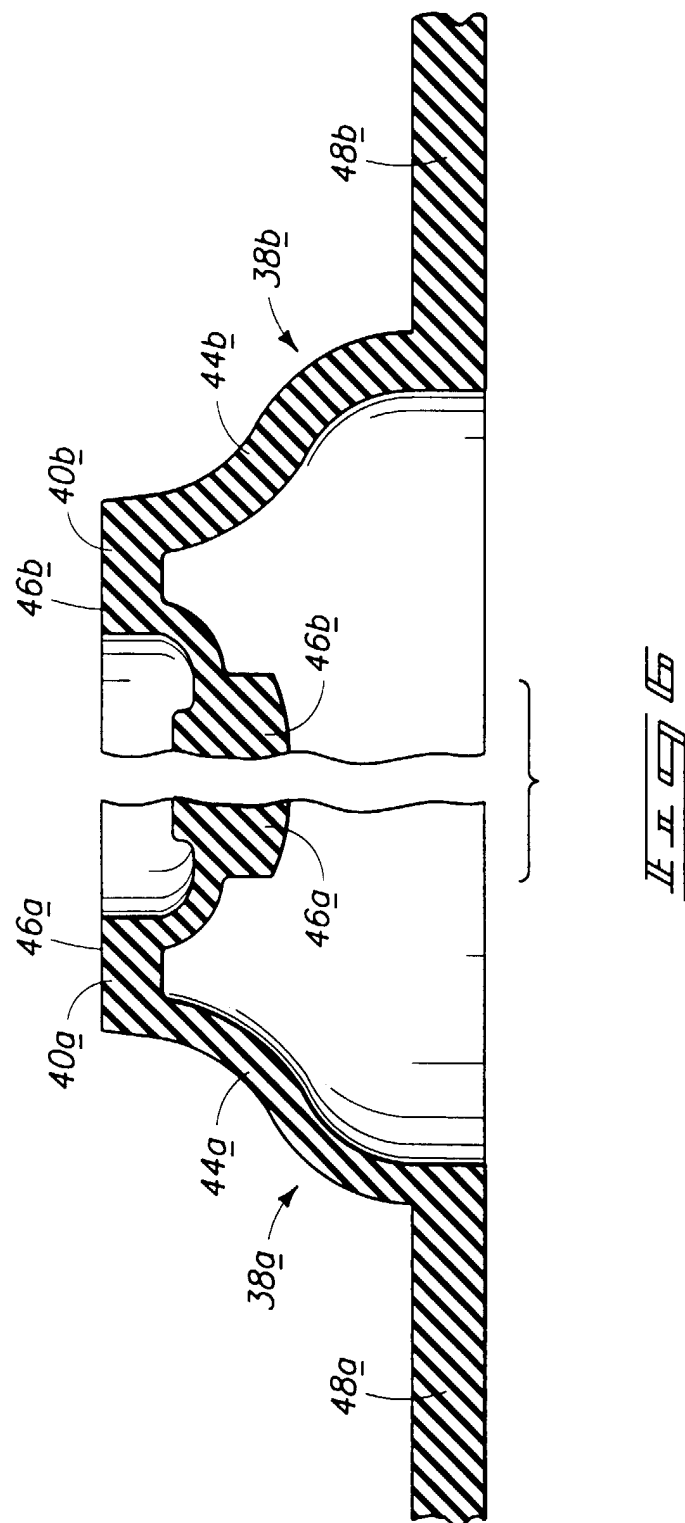


Fig. 5

Fig. 6



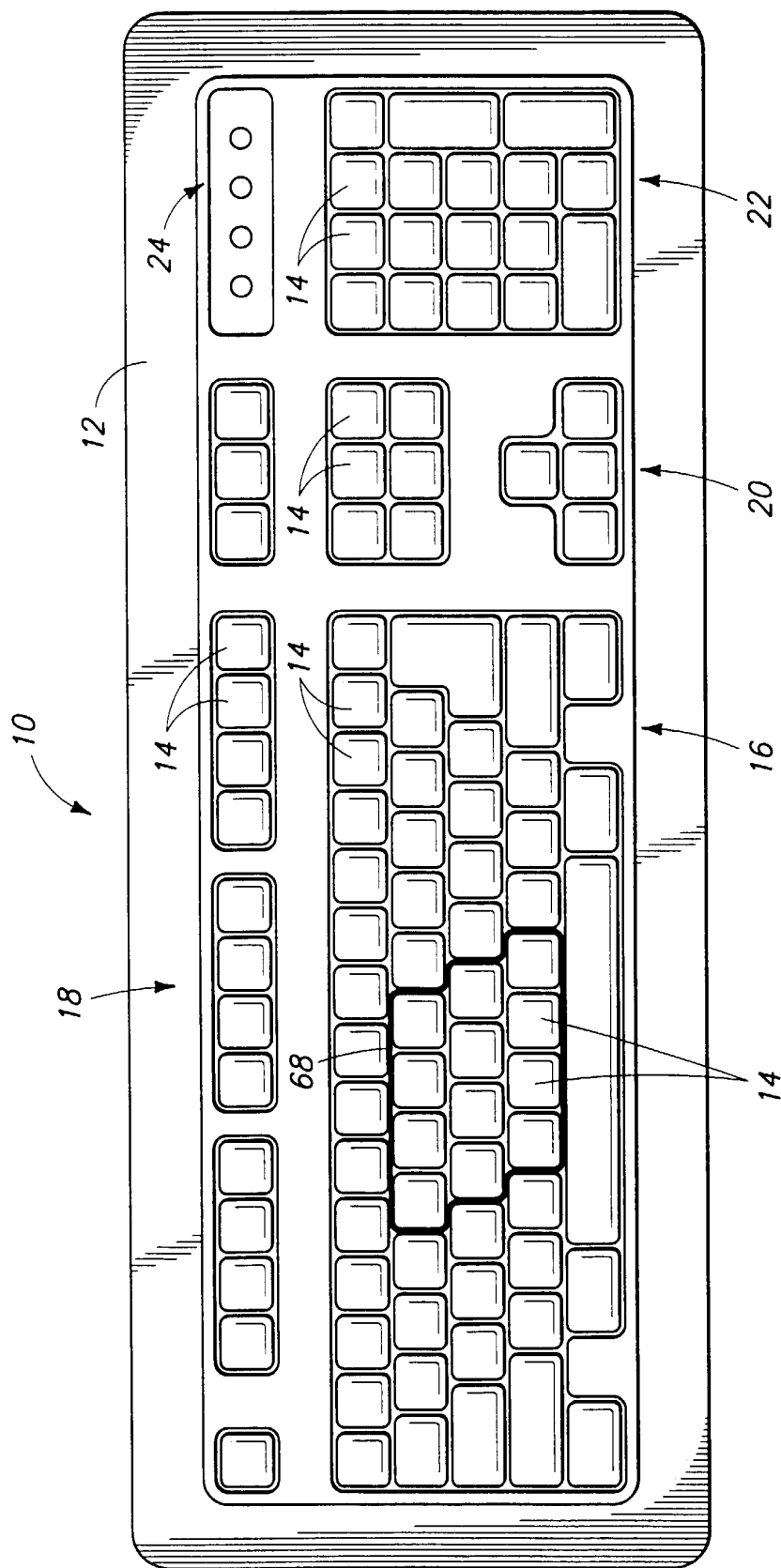
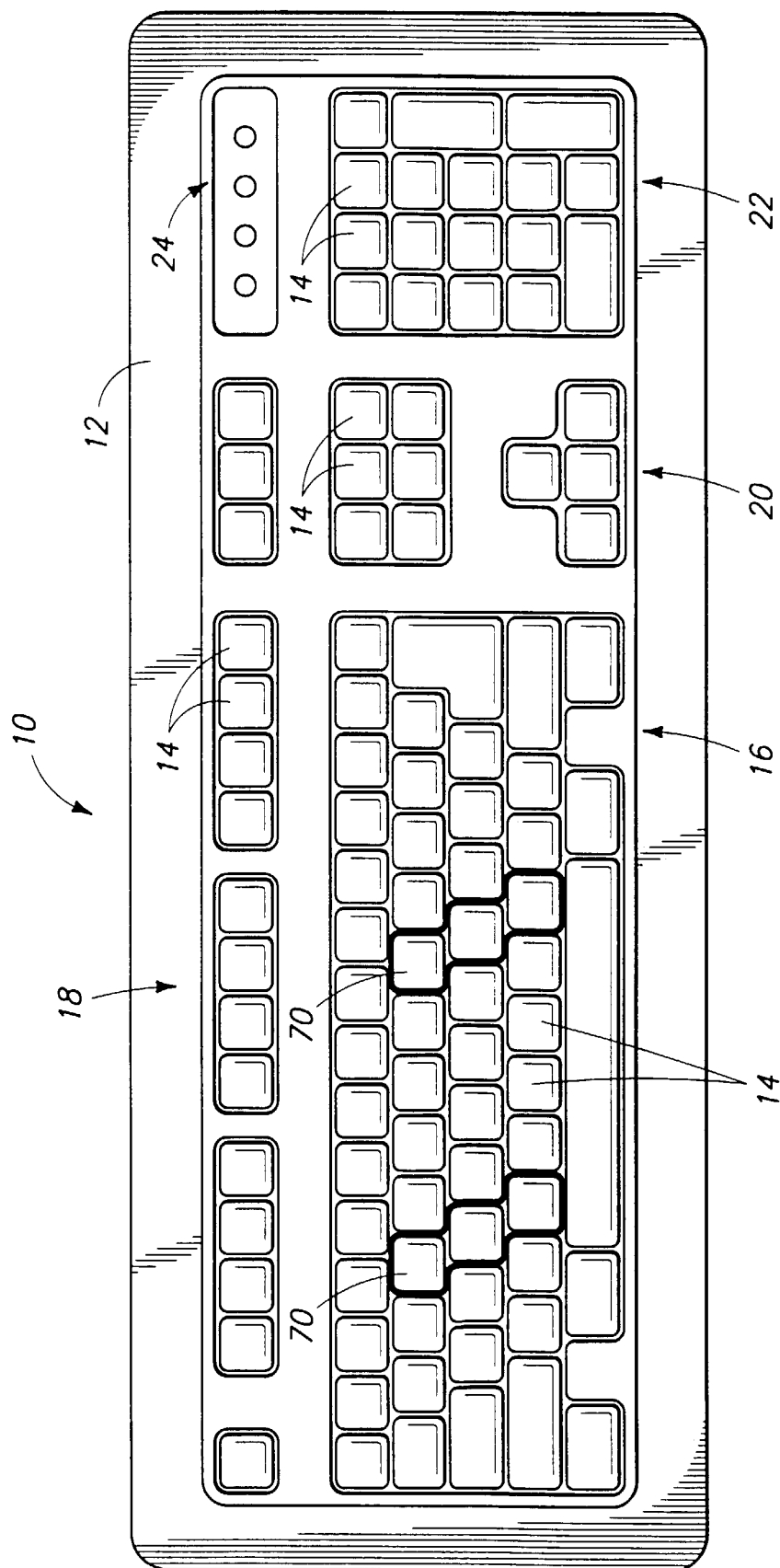


Fig. 1



Il x 05 BB

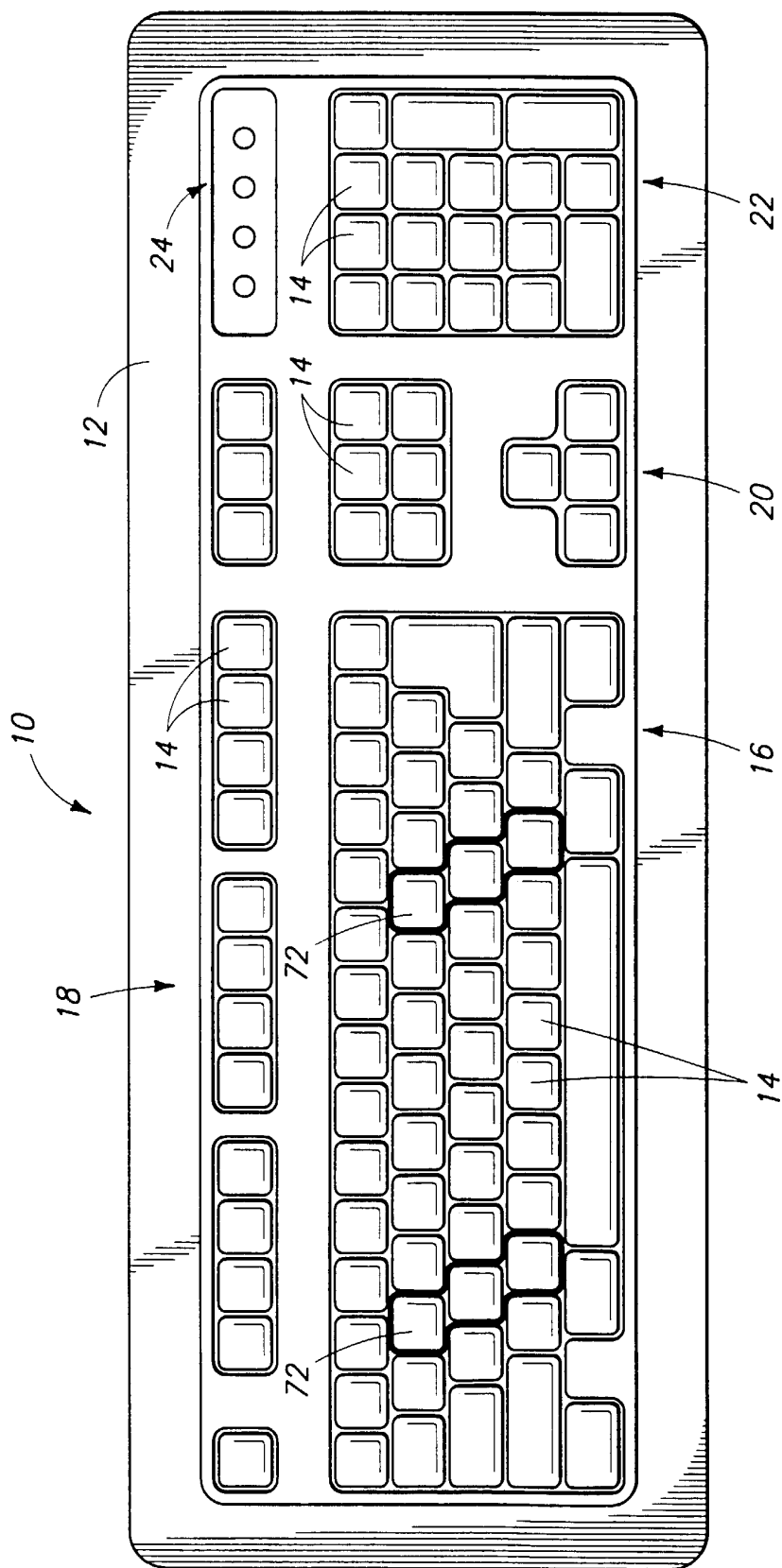
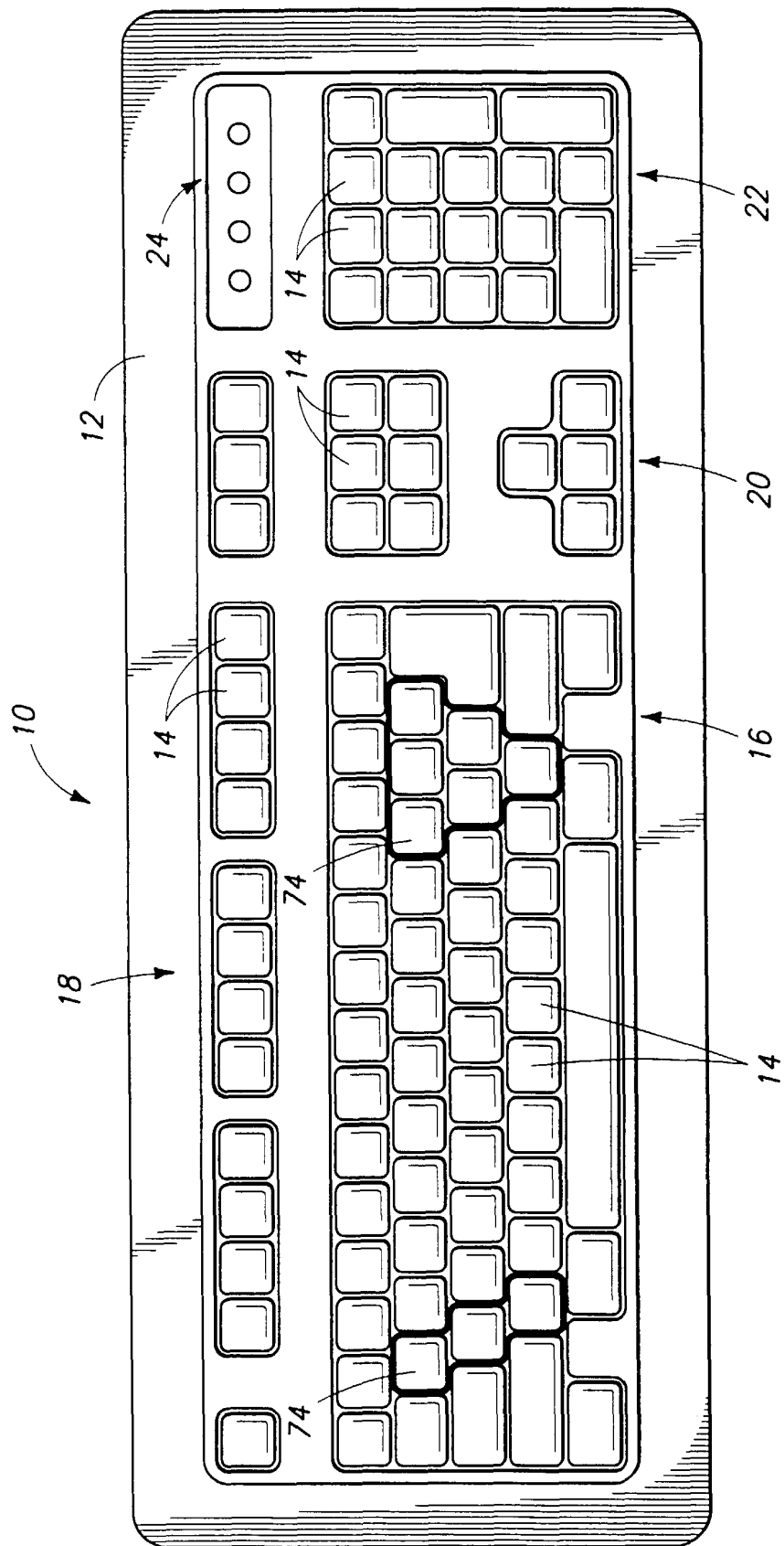
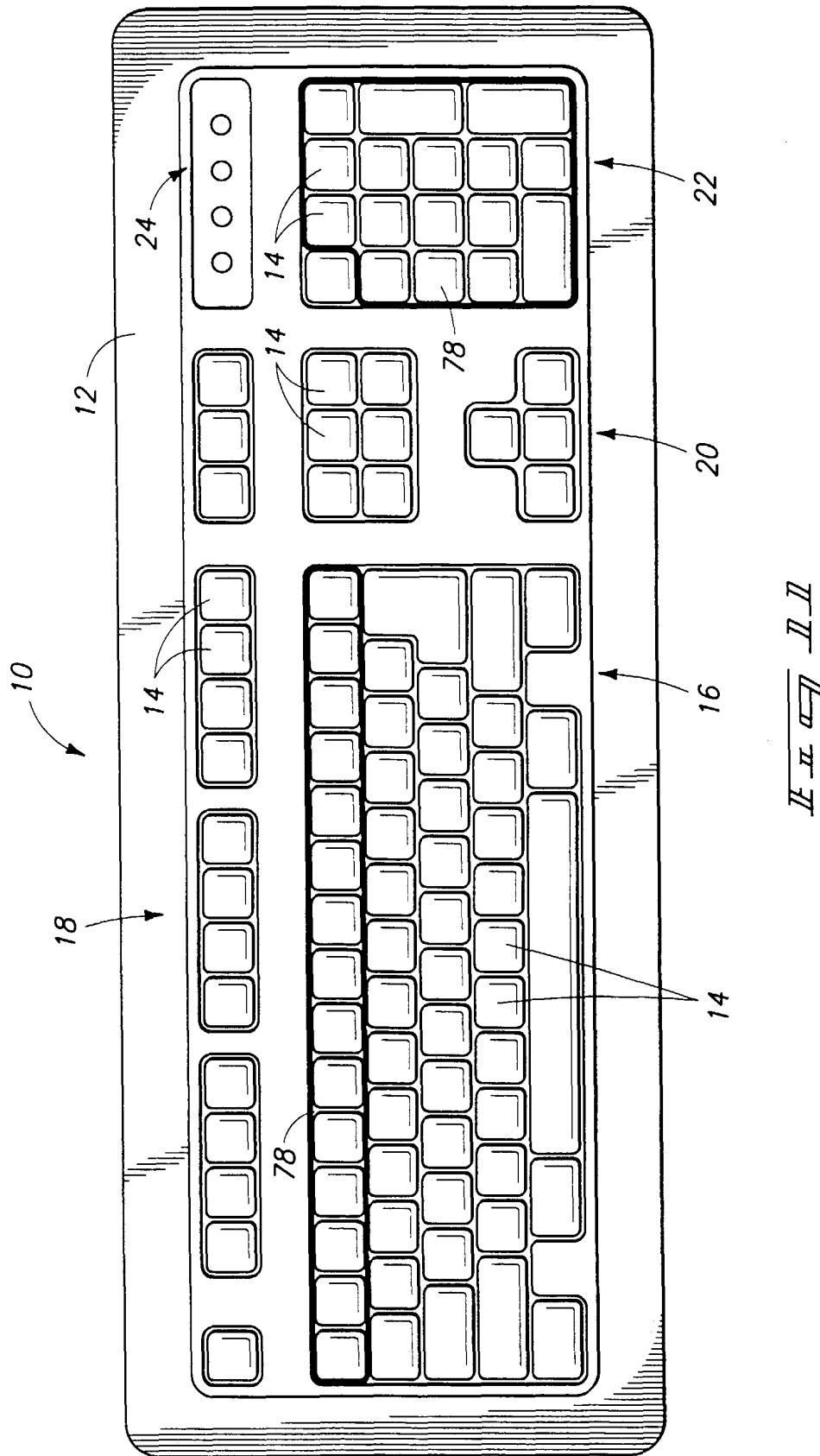
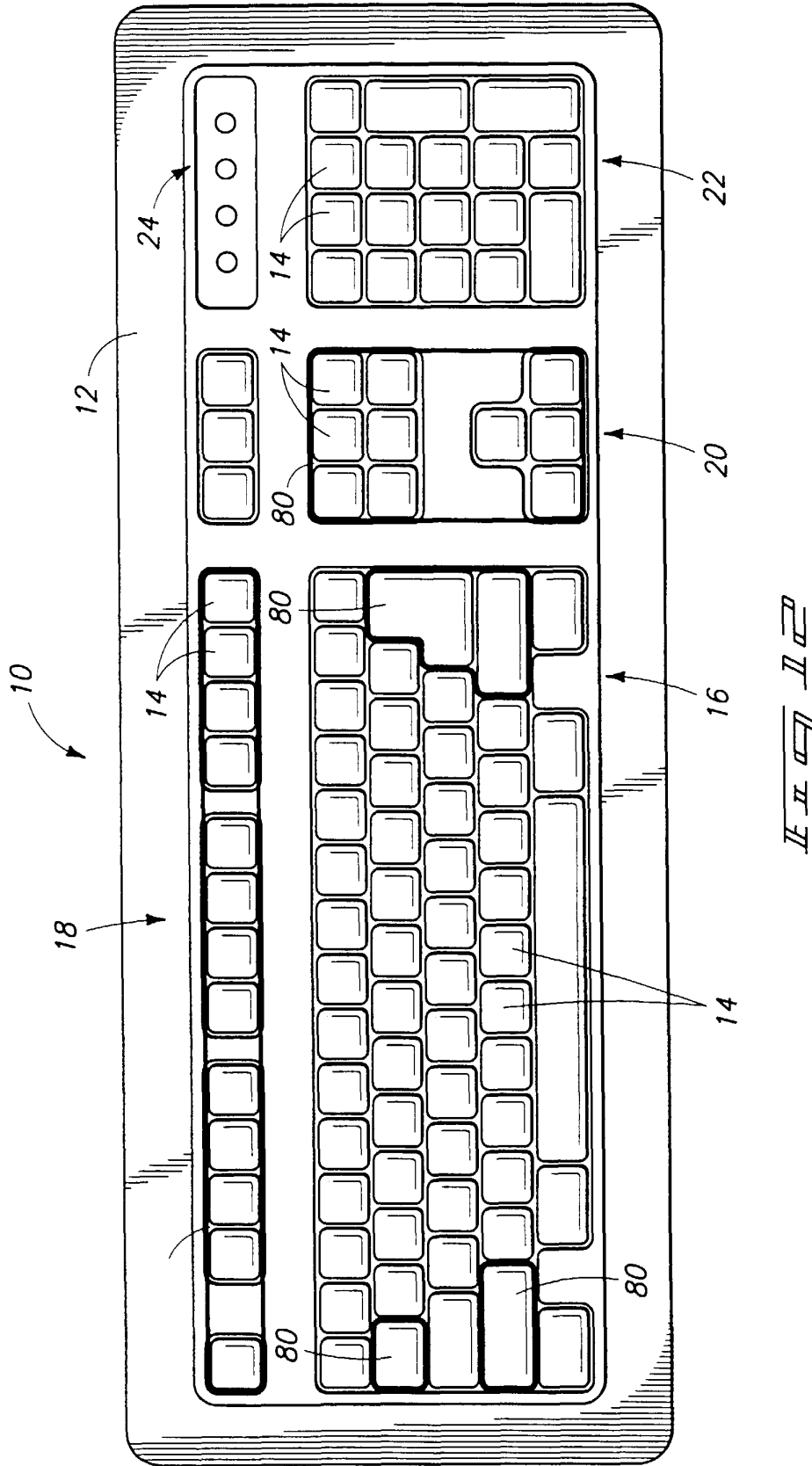


Fig. 1


$$\frac{100}{1000000}$$





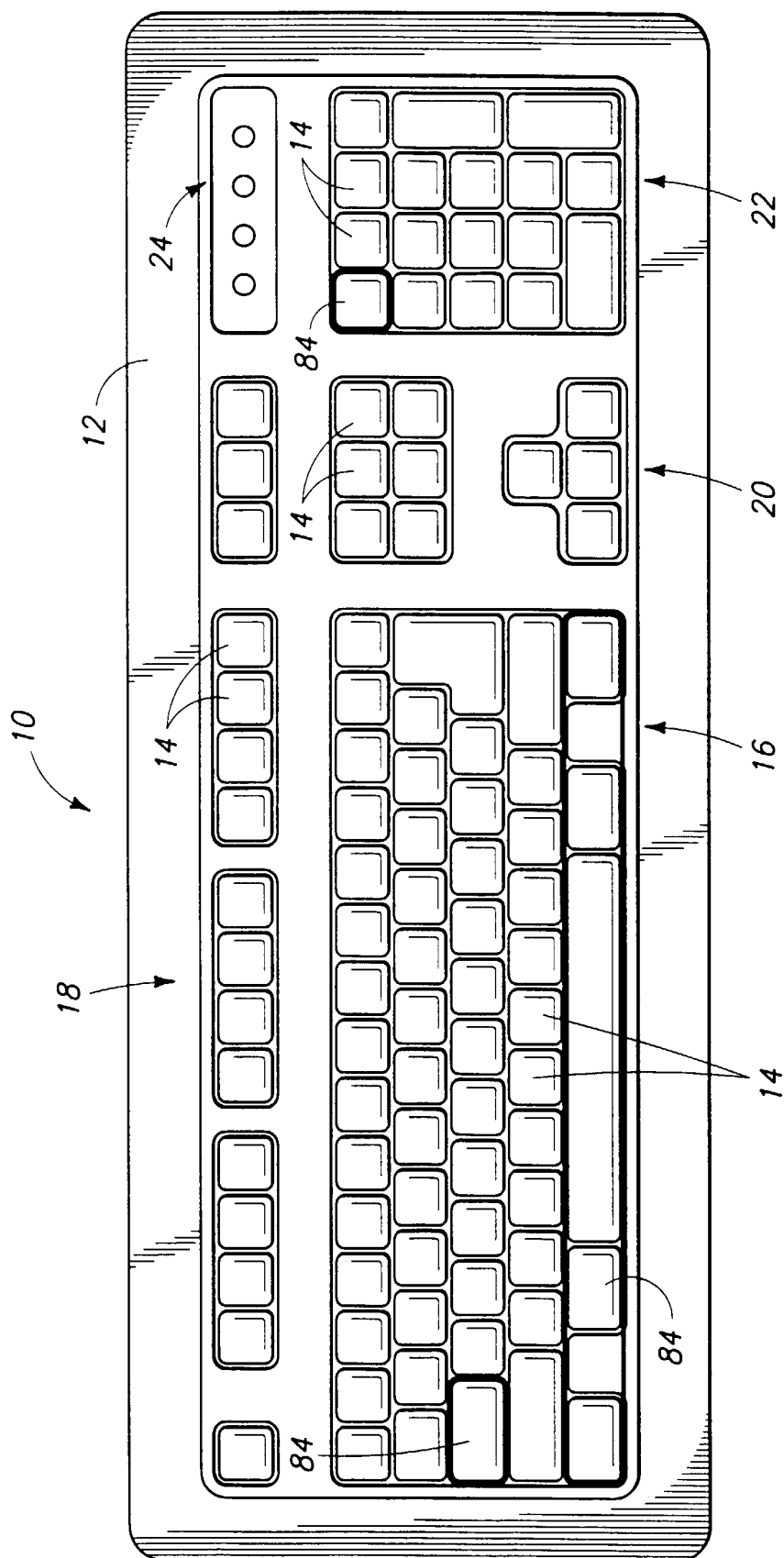
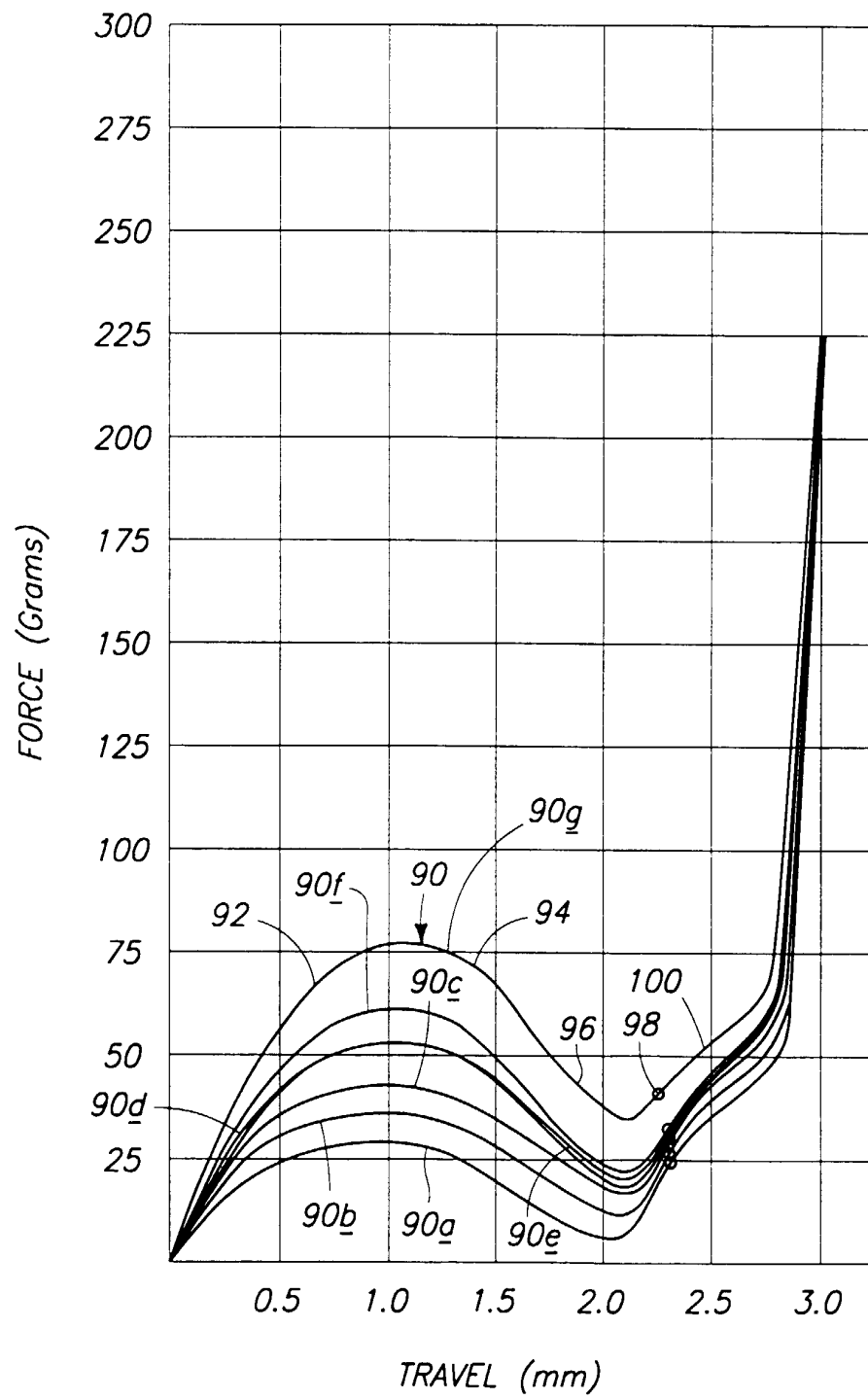


FIG. 1



Итого 14